PATENT ABSTRACTS OF JAPAN

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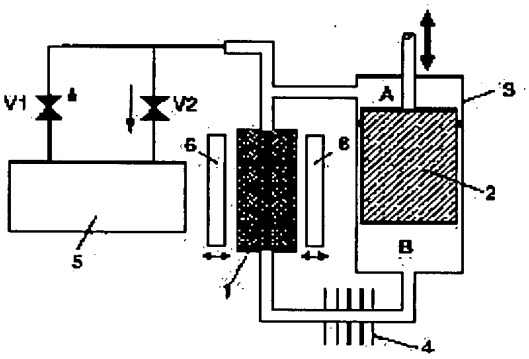
(54) REFRIGERATING MACHINE

(57)Abstract:
PROBLEM TO BE SOLVED: To remarkably make rapid progress of refrigerating ability, by using ErNi as cool storage material of a cool storage unit of a refrigerating machine, and applying a magnetic field to the material.
SOLUTION: A refrigerating machine comprises a magnetic field applying means 6 for applying a magnetic field to the vicinity of a cool storage unit 1 of a conventional refrigerating machine. A suitable magnet such as a permanent magnet or an electromagnet can be used as the means 6, and magnetic field control of the means 6 can be conducted by a suitable means. Cool storage material used for the unit 1 of the machine is ErNi, and the field can be applied in various state to the material by the means 6. Thus, refrigerating ability can be largely improved as compared with conventional gas refrigerating machine. And, an intensity of the field to be applied to the material is changed synchronously with a refrigerating machine cycle to thereby easily increase refrigerating ability.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The refrigerator characterized by using ErNi as a cold reserving material of the regenerator of a refrigerator.
[Claim 2] The refrigerator characterized by constituting so that a magnetic field can be impressed to said cold reserving material while using ErNi as a cold reserving material of the regenerator of a refrigerator.
[Claim 3] The refrigerator characterized by enabling it to impress a magnetic field to said cold reserving material, and changing said magnetic field strength further synchronizing with a refrigerator cycle while using ErNi as a cold reserving material of the regenerator of a refrigerator.
[Claim 4] Said magnetic field is a refrigerator according to claim 3 characterized by constituting that a permanent magnet should give.
[Claim 5] Said magnetic field strength is a refrigerator according to claim 3 characterized by making it make it change by moving a permanent magnet to a cold reserving material.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the refrigerator excellent in the refrigerating capacity using ErNi as a cold reserving material about a refrigerator.
[0002]
[Description of the Prior Art] As a very low temperature refrigerator, the GM (Giffrd-McMahon) refrigerator is used widely today. If the outline configuration of the conventional GM refrigerator is explained with reference to drawing 5 , the refrigerator with which the piston at which one has arranged regenerator and 2 in a cylinder 3, enabling free sliding, and 4 are bulbs, and a heat exchanger and 5 were constituted [4] for a compressor, and V1 and V2 by these will carry out the following actuation among drawing.
[0003] At first, a piston 2 is in the bottom (method of drawing Nakashita) of a cylinder 3, and high-pressure gaseous helium is introduced into A rooms and regenerator 1 in a cylinder 3 from a compressor 5 through a bulb V1. Next, a piston 2 is raised with the bulb V1 opened, and the gaseous helium of the cylinder 3A interior of a room is moved to B rooms through regenerator 1. This is called a hot blow. Since that volume contracts when gaseous helium passes regenerator 1, this actuation is performed opening a bulb V1 so that isotonic conditions may be satisfied.
[0004] Next, a bulb V1 is shut, a bulb V2 is opened, and the pressure of B rooms in a cylinder 3 is lowered. Gaseous helium expands in this process, and refrigeration is performed when temperature decreases. Finally a piston 2 is lowered and low-temperature gaseous helium moves to A rooms through a heat exchanger 4 and regenerator 1 from B in a cylinder 3. This is called call TOBURO. In the above-mentioned refrigerator, operation is performed by making the above processes into 1 cycle.
[0005]
[Problem(s) to be Solved by the Invention] Although the big ingredient of the specific heat was required as an ingredient "a cold reserving material" used for regenerator 1 in this system, in the conventional GM refrigerator, Er3 nickel and Pb were used as a cold reserving material. However, it could not say that Er3 nickel and Pb had specific heat sufficient as a cold reserving material, but a new cold reserving material which has the still bigger specific heat was desired.
[0006] In such a background, the bigger specific heat than cold reserving material Er3 nickel, Pb, etc. conventional in the 10.5K neighborhood ErNi transfers this invention person etc. to ferromagnetism from a paramagnetism is shown, it checks that it is promising as a cold reserving material, and this invention is carried out based on this knowledge. The actual measurement of the specific heat in the inside of the magnetic field of an ErNi cold reserving material is shown in drawing 2 . The specific heat in Er3 nickel used with the conventional GM refrigerator for a comparison or the zero magnetic field of Pb is also shown together. It turns out that ErNi is very promising as a cold reserving material so that clearly also from this drawing.
[0007] Since large ErNi of the specific heat was used as a cold reserving material, while the effectiveness of a refrigerator improves, refrigerating capacity can be made to have a logical

jump remarkably by impressing a fixed magnetic field to ErNi in the refrigerator by this invention.

[0008]
[Means for Solving the Problem] For this reason, the technical solution means which this invention adopted While being the refrigerator characterized by using ErNi as a cold reserving material of the regenerator of a refrigerator and using ErNi as a cold reserving material of the regenerator of a refrigerator While being the refrigerator characterized by constituting so that a magnetic field can be impressed to said cold reserving material and using ErNi as a cold reserving material of the regenerator of a refrigerator It is the refrigerator characterized by enabling it to impress a magnetic field to said cold reserving material, and changing said magnetic field strength further synchronizing with a refrigerator cycle.
[0009]
[Embodiment of the Invention] If the gestalt of operation of this invention is hereafter explained based on a drawing, drawing 1 is the block diagram of the refrigerator concerning the gestalt of operation of this invention, this refrigerator is equipped with a magnetic field impression means 6 to impress a magnetic field near the regenerator 1 of the conventional refrigerator mentioned above, and other requirements for a configuration are the same as usual. As said magnetic field impression means 6, a permanent magnet, an electromagnet, etc. can use a magnet suitably, and a means can also perform suitably magnetic field control of the magnetic field impression means 6. For example, when a permanent magnet is used, magnetic field strength can be changed into a cold reserving material by bringing close or keeping away a permanent magnet, and various kinds of actuators can be used as a migration means of a permanent magnet.
[0010] The cold reserving material used for the regenerator 1 of the refrigerator of the above-mentioned configuration is ErNi, and enables it to have impressed the magnetic field to this cold reserving material with various gestalten with the magnetic field impression means as mentioned above. Temperature of 30K and the source of the low fever is set to 4K for the temperature of the source of high temperature, and the result of the simulation of the refrigerating capacity (Pr/Pi) at the time of impressing a magnetic field to it is shown in drawing 3 , using ErNi as a cold reserving material. Here, it is Pi. Pr of an ideal The refrigerating capacity of the actual GM refrigerator is expressed and the die length of the part to which L1 impressed the overall length of a cool storage machine, and L2 impressed the magnetic field of them is expressed. Moreover, B (T) expresses an impression magnetic field with the unit of a tesla. At the time of L2/L1=0.55 and B(T) =2.1T, maximum is 0.695 and this value becomes 1.34 times compared with the value 0.52 when not impressing a magnetic field so that clearly from drawing. Thus, when ErNi impressed a fixed magnetic field, it became in ** and others that refrigerating capacity increases.
[0011] Next, it is a magnetic field BH to regenerator before a cold blow. Heat insulation excitation is impressed and carried out. The heat generated at this time is carried to the source of high temperature by gaseous helium at the time of the cold blow just behind that. Conversely, magnetic field BH which has started regenerator before the hot blow Heat insulation demagnetization is carried out and it is BL. The temperature of regenerator is lowered by carrying out. The gaseous helium which passes regenerator by hot blow immediately after that is cooled, and the source of the low fever becomes low temperature more. Since not only gas refrigeration (GM refrigeration) but the effectiveness of magnetic refrigeration is added by this actuation, refrigerating capacity increases. This can be called "hybrid refrigerator" of magnetic refrigeration and gas refrigeration.
[0012] Drawing 4 is a magnetic field BH. BL Combination and the relation of refrigerating capacity are shown. A maximum of 0.773 is shown at the time of BL =0.2T and BH =0.39T. It is shown that this value becomes 1.5 times as many refrigerating capacity as this compared with the time of not impressing a magnetic field. Since the surface magnetic field of the strongest permanent magnet (Ne-Fe-B) by which current marketing is carried out is about 0.3T, when using this magnet, refrigerating capacity 0.68 is acquired from drawing as BL =0.14T and BH =0.3T. It is shown that this value becomes 1.3 times as many refrigerating capacity as this

compared with the value 0.52 when not impressing a magnetic field. Synchronizing with a refrigerating cycle, it brings close to regenerator, or this only keeps away a magnet, and shows that refrigerating capacity becomes 1.3 times easily.

[0013] As mentioned above, this invention can increase refrigerating capacity sharply by impressing a magnetic field to a cold reserving material further as compared with the conventional refrigerator, using ErNi as a cold reserving material. In this case, it cannot be overemphasized that not only a permanent magnet but an electromagnet etc. can be used as a means to impress a magnetic field. Moreover, it brings a permanent magnet close with a means suitably or the magnetic field strength impressed to a cold reserving material not only keeps it away, but the current control to an electromagnet etc. can perform it. In addition, this invention can be carried out in other various forms, without deviating from the pneuma and main descriptions, therefore don't pass over the gestalt of the above-mentioned operation to mere instantiation, and don't interpret it restrictively. Furthermore, all of the deformation and modification belonging to the equal range of a claim are the things of this invention within the limits.

[0014]

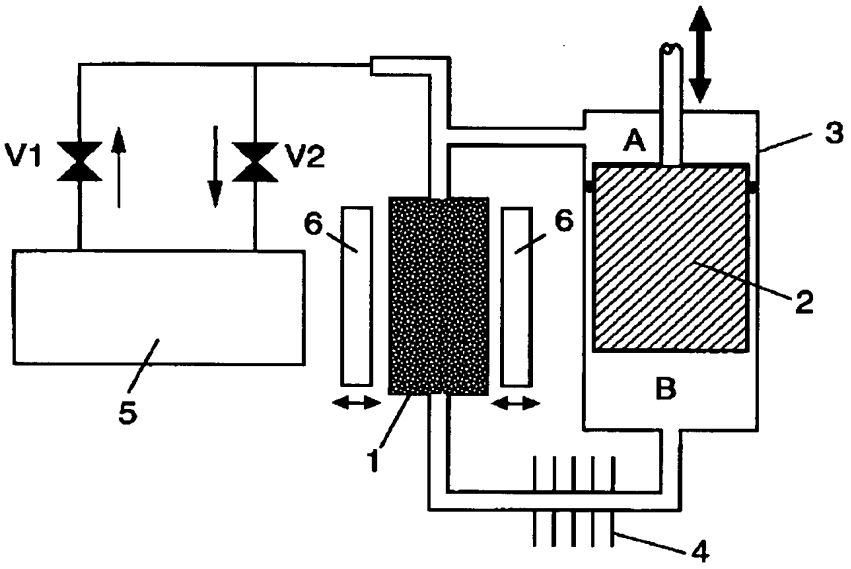
[Effect of the Invention] Since high ErNi of the specific heat was used as a cold reserving material according to this invention as explained to the detail above, as compared with the conventional gas refrigerator, refrigerating capacity can be improved sharply. Moreover, the effectiveness which can increase refrigerating capacity easily and which was excellent in ** can be done so by changing the magnetic field strength impressed to a cold reserving material synchronizing with a refrigerator cycle.

[Translation done.]

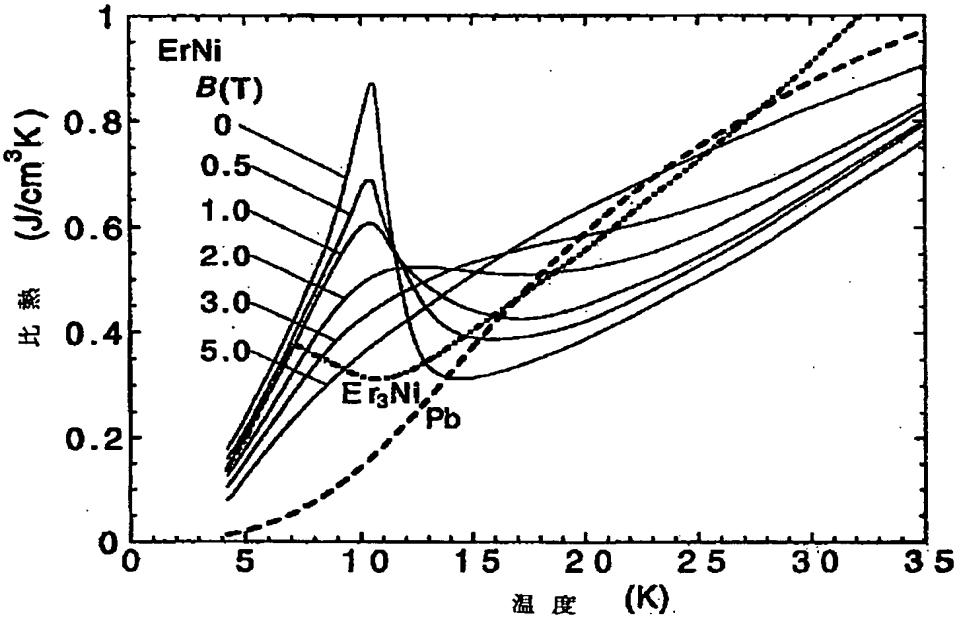
* NOTICES *

DRAWINGS

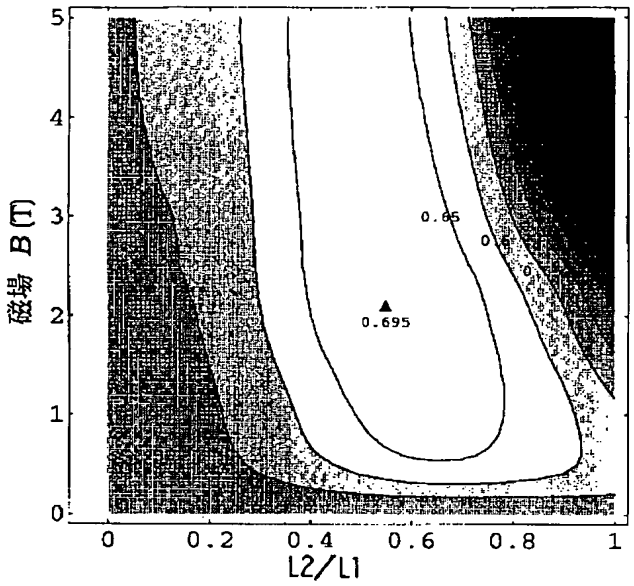
[Drawing 1]



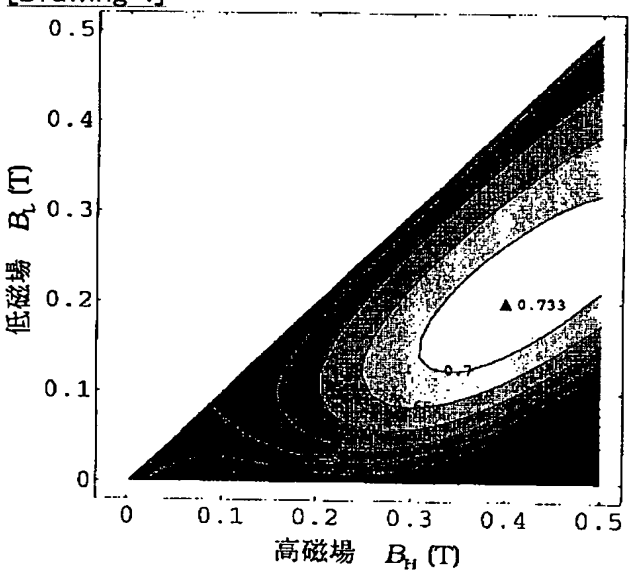
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Drawing 5]